Lloyd's Register

Rules and Regulations for the Classification of Ships, July 2006

Notice No. 2

Effective Date of Latest Amendments:

See page 1

Issue date: October 2006

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RULES AND REGULATIONS FOR THE CLASSIFICATION OF SHIPS, *July 2006*

Notice No. 2

This Notice contains amendments within the following Sections of the *Rules and Regulations for the Classification of Ships, July 2006.* The amendments are effective on the dates shown:

Part	***Chapter***	***Section***	***Effective date***
5	2	4, 6, 13, 14	1 January 2007

The *Rules and Regulations for the Classification of Ships, July 2006* are to be read in conjunction with this Notice No. 2. The status of the Rules is now:

Rules for Ships	Effective date:	July 2006
Notice No. 1	Effective dates:	1 April, 1 July 2006 & Corrigenda
Notice No. 2	Effective date:	1 January 2007

Part 5, Chapter 2
Oil Engines

(Effective date 1 January 2007)

■ *Section 4*
Construction and welded structures

4.1 Crankcases

4.1.1 Crankcases and their doors are to be of robust construction to withstand anticipated crankcase pressures that may arise during a crankcase explosion, taking into account the installation of explosion relief valves required by Section 6 and the doors are to be securely fastened so that they will not be readily displaced by ~~an~~ a crankcase explosion.

■ *Section 6*
Crankcase safety fitting

6.1 Relief valves

6.1.4 The valves are to be provided with a copy of the manufacturer's installation and maintenance manual for the size and type of valve being supplied for installation on a particular engine. The manual is to contain the following information:

- Description of valve with details of function and design limits.
- Copy of type test certification.
- Installation instructions.
- Maintenance and in service instructions to include testing and renewal of any sealing arrangements.
- Actions required after a crankcase explosion.

6.1.5 A copy of the installation and maintenance manual required by 6.1.4 is to be provided on board the ship.

6.1.6 Plans showing details and arrangements of the relief valves are to be submitted for approval, *see* 1.1.

6.1.7 The valves are to be provided with suitable markings that include the following information:

- Name and address of manufacturer.
- Designation and size.
- Month/Year of manufacture.
- Approved installation orientation.

6.9 Oil mist detection/monitoring

6.9.1 Where crankcase oil mist detection/monitoring arrangements are fitted, they are to be of a type approved by LR, tested in accordance with Section 14 and comply with 6.9.2 to 6.9.15.

6.9.2 The oil mist detection/monitoring system and arrangements are to be installed in accordance with the engine designer's and oil mist detection equipment manufacturer's instructions/recommendations. The following particulars are to be included in the instructions:

(a) Schematic layout of engine oil mist detection/monitoring and alarm system showing locations of engine crankcase sample points and piping arrangements together with pipe dimensions to detector/monitor.
(b) Evidence of study to justify the selected locations of sample points and sample extraction rate (if applicable) in consideration of the crankcase arrangements and geometry and the predicted crankcase atmosphere where oil mist can accumulate.
(c) The manufacturer's maintenance and test manual.
(d) Information relating to type or in-service testing of the engine with engine protection system test arrangements having approved types of oil mist monitoring equipment.

6.9.3 A copy of the oil mist detection/monitoring equipment maintenance and test manual required by 6.9.2 is to be provided on board ship.

6.9.4 Oil mist monitoring and alarm information is to be capable of being read from a safe location away from the engine.

6.9.5 In the case of multi engine installations, each engine is to be provided with oil mist detection/monitoring and a dedicated alarm.

6.9.6 Oil mist detection/monitoring and alarm systems are to be capable of being tested on the test bed and on board when the engine is at a standstill and when the engine is running at normal operating conditions in accordance with test procedures that are acceptable to LR.

6.9.7 Alarms and shutdowns for the oil mist detection/monitoring system are to be in accordance with Pt 6, Ch 1 as applicable.

6.9.8 The oil mist detection/monitoring arrangements are to provide an alarm indication in the event of a foreseeable functional failure in the equipment and installation arrangements. *See* Pt 6, Ch 1,2.4.6.

6.9.9 The oil mist detection/monitoring system is to provide an indication that any lenses fitted in the equipment and used in determination of the oil mist level have been partially obscured to a degree that will affect the reliability of the information and alarm indication.

6.9.10 Where oil mist detection/monitoring equipment includes the use of programmable electronic systems, the arrangements are to be in accordance with Pt 6, Ch 1 as applicable.

6.9.11 Schematic layouts showing details and arrangements of oil mist detection/monitoring and alarm systems are to be submitted. *See* Pt 5, Ch 1,1.

6.9.12 The equipment together with detectors/monitors is to be tested when installed on the test bed and on board ship to demonstrate that the detection/monitoring and alarm system functions correctly. The testing arrangements are to be to the satisfaction of the Surveyor.

6.9.13 Where sequential oil mist detection/monitoring arrangements are provided, the sampling frequency and time is to be as short as reasonably practicable.

6.9.14 Where alternative methods are provided for the prevention of the build-up of oil mist that may lead to a potentially explosive condition within the crankcase, detailed information is to be submitted for consideration. The information is to include:

(a) Engine particulars – type, power, speed, stroke, bore and crankcase volume.
(b) Details of arrangements designed to prevent the build up of potentially explosive conditions within the crankcase, e.g., bearing temperature monitoring, oil splash temperature monitoring, crankcase pressure monitoring, and recirculation arrangements.
(c) Evidence to demonstrate that the arrangements are effective in preventing the build up of potentially explosive conditions together with details of in-service experience.
(d) Operating instructions and the maintenance and test instructions.

6.9.15 Where it is proposed to use the introduction of inert gas into the crankcase to minimise a potential crankcase explosion, details of the arrangements are to be submitted for consideration.

■ *Section 13*
Type testing procedure for crankcase explosion relief valves

13.1 Scope

13.1.1 This test procedure identifies standard conditions by which crankcase explosion relief valves intended to be fitted to diesel engines can be tested to demonstrate that they satisfy LR requirements for type testing to a defined standard.

13.1.2 This test procedure is also applicable to explosion relief valves intended for gear cases.

13.1.3 Standard repeatable test conditions have been established using a methane gas and air mixture.

13.1.4 The test procedure is only applicable to explosion relief valves fitted with flame arresters.

13.2 Purpose

13.2.1 The purpose of type testing crankcase explosion relief valves is fourfold:

(a) To verify the effectiveness of the flame arrester.
(b) To verify that the valve closes after an explosion.
(c) To verify that the valve is gas/air tight after an explosion.
(d) To establish the level of over-pressure protection provided by the valve.

13.3 Test facilities

13.3.1 The test facilities for carrying out type testing of crankcase explosion relief valves are to meet the following requirements:

(a) The test facilities where testing is carried out are to be accredited to a National or International Standard for the testing of explosion protection devices.
(b) The test facilities are to be acceptable to LR.
(c) The test facilities are to be equipped so that they can control and record explosion testing in accordance with this procedure.
(d) The test facilities are to have equipment for controlling and measuring a methane gas in air concentration within a test vessel to an accuracy of ± 0.1%.
(e) The test facilities are to be capable of effective point-located ignition of a methane gas in air mixture.
(f) The pressure measuring equipment is to be capable of measuring the pressure in the test vessel in at least two positions, one at the valve and the other at the test vessel centre. The measuring arrangements are to be capable of measuring and recording the pressure changes throughout an explosion test. The result of each test is to be documented by video recording and if necessary by recording with a heat sensitive camera.
(g) The test vessel for explosion testing is to have documented dimensions that are to be such that its height or length between dished ends is approximately 2 times its diameter but not more than 2.5 times. The internal volume of the test vessel is to be determined from the vessel dimensions that include any standpipe arrangements.
(h) The test vessel for explosion testing is to be provided with a flange for mounting the explosion relief valve in an orientation consistent with how it will be installed in service, i.e., in the vertical plane or the horizontal plane. The flange arrangement is to be made approximately one third of the height or length of the test vessel.
(j) A circular flat plate having the following dimensions is to be provided for fitting between the pressure vessel flange and valve to be tested:
    (i) Outside diameter = 2 x *D* where *D* is the outer diameter of the valve top cover. The circular plate is to provide simulation of the crankcase surface.
    (ii) Internal bore having the same internal diameter as the valve to be tested.
(k) The test vessel for explosion testing is to have connections for measuring the methane in air mixture in at least two positions, i.e., top and bottom.
(l) The test vessel for explosion testing is to be provided a means of fitting an ignition source at a position approximately one third the height or length of the vessel, *see* 13.4.3.

(m) The test vessel volume is to be as far as practicable, related to the size of relief valve to be tested. In general, the volume is to correspond to the requirement in 6.3.1 for the free area of explosion relief valve to be not less than 115 cm^2/m^3 of crankcase gross volume, e.g., the testing of a valve having 1150 cm^2 of free area, would require a test vessel with a volume of 10 m^3. In no case is the volume of the test vessel to vary by more than +15 per cent to –10 per cent or from the 115 cm^2/m^3 volume ratio.

13.4 Explosion test process

13.4.1 All explosion tests to verify the functionality of crankcase explosion relief valves are to be carried out using an air and methane mixture with a methane concentration of 9,5 per cent ±0,5 per cent. The pressure in the test vessel is to be not less than atmospheric and not exceed 0,2 bar.

13.4.2 The concentration of methane in the test vessel is to be measured at the top and bottom of the vessel and these concentrations are not to differ by more than 0,5 per cent.

13.4.3 The ignition of the methane and air mixture is to be made at a position approximately one third of the height or length of the test vessel opposite to where the valve is mounted.

13.4.4 The ignition is to be made using a 100 joule explosive charge.

13.5 Valves to be tested

13.5.1 The valves used for type testing are to be manufactured and tested in accordance with procedures acceptable to LR and selected from the manufacturer's usual production line for such valves by the LR Surveyor witnessing the tests.

13.5.2 For approval of a specific valve size, three valves of that specific size are to be tested. The valves are to have been tested at the manufacturer's works to demonstrate that the opening pressure is in accordance with that agreed by the engine builder and valve manufacturer within a tolerance of ±20 per cent and that the valve is air tight at a pressure below the opening pressure for at least 30 seconds.

13.5.3 The selection of valves for type testing is to recognize the orientation in which they are intended to be installed on the engine or gear case. Where it is intended that valves be installed in the vertical or near vertical or the horizontal or near horizontal position, then three valves of each size are to be tested for each intended orientation.

13.6 Method

13.6.1 The following requirements are to be satisfied at explosion testing:

(a) The explosion testing is to be witnessed by a LR Surveyor where type testing approval is required by LR.

(b) Valves are to be tested in the vertical or horizontal position consistent with the orientation in which they are intended to be installed on an engine or gear case, usually in the vertical position, *see* 13.5.3.

(c) Where valves are to be installed on an engine or gear case with shielding arrangements to deflect the emission of explosion combustion products, the valves are to be tested with the shielding arrangements fitted.

(d) Type testing is to be carried out for each range of valves for which a manufacturer requires LR approval.

(e) Successive explosion testing to establish a valve's functionality is to be carried out as quickly as possible during stable weather conditions.

(f) The pressure rise and decay during all explosion testing is to be recorded.

(g) The external condition of the valves is to be monitored during each test. The test facility is to produce a report on the explosion test findings.

13.6.2 The explosion testing is to be in three stages for each valve that is required to be approved as being type tested.

13.6.3 **Stage 1.** Two explosion tests are to be carried out with the flange opening fitted with the circular plate covered by a 0,05 mm thick polythene film. These tests establish a reference pressure level for determination of the effects of a relief valve in terms of pressure rise in the test vessel, *see* 13.7.1(f).

13.6.4 **Stage 2**:

(a) Two explosion tests are to be carried out on three different valves of the same size. Each valve is to be mounted in the orientation for which approval is sought i.e., in the vertical or horizontal position with the circular plate described in 13.3.1(j) located between the valve and pressure vessel mounting flange.

(b) The first of the two tests on each valve is to be carried out with a 0,05mm thick polythene bag, having a minimum diameter of three times the diameter of the circular plate and volume not less than 30 per cent of the test vessel, enclosing the valve and circular plate. Before carrying out the explosion test the polythene bag is to be empty of air. The polythene bag is required to provide a readily visible means of assessing whether there is flame transmission through the relief valve following an explosion.

(c) Provided that the first explosion test successfully demonstrated that there was no indication of combustion outside the flame arrester and there are no signs of damage to the flame arrester or valve, a second explosion test without the polythene bag arrangement is to be carried out. During the second explosion test, the valve is to be visually monitored for any indication of combustion outside the flame arrester. The second test is required to demonstrate that the valve can still function in the event of a secondary crankcase explosion.

(d) After each explosion, the test vessel is to be maintained in the closed condition for at least 10 seconds to enable the tightness of the valve to be ascertained. The tightness of the valve can be verified during the test from the pressure/time records or by a separate test after completing the second explosion test.

13.6.5 **Stage 3**. Carry out two further explosion tests as described in Stage 1. These further tests are required to provide an average baseline value for assessment of pressure rise, recognizing that the test vessel ambient conditions may have changed during the testing of the explosion relief valves in Stage 2.

13.7 Assessment

13.7.1 Assessment of the valves after explosion testing is to address the following:

(a) The valves to be tested are to have evidence of appraisal/approval by LR, *see also* 13.5.1.
(b) The designation, dimensions and characteristics of the valves to be tested are to be recorded. This is to include the free area of the valve and of the flame arrester and the amount of valve lift at 0,2 bar.
(c) The test vessel volume is to be determined and recorded.
(d) For acceptance of the functioning of the flame arrester there is not to be any indication of flame or combustion outside the valve during an explosion test.
(e) The pressure rise and decay during an explosion is to be recorded, with indication of the pressure variation showing the maximum overpressure and steady underpressure in the test vessel during testing. The pressure variation is to be recorded at two points in the pressure vessel.
(f) The effect of an explosion relief valve in terms of pressure rise following an explosion is ascertained from maximum pressures recorded at the centre of the test vessel during the three stages. The pressure rise within the test vessel due to the installation of a relief valve is the difference between average pressure of the four explosions from Stages 1 and 3 and the average of the first tests on the three valves in Stage 2.
(g) The valve tightness is to be ascertained by verifying from records that an underpressure of at least 0,3 bar is held by the test vessel for at least 10 seconds following an explosion.
(h) After each explosion test in Stage 2, the external condition of the flame arrester is to be examined for signs of damage and/or deformation.
(j) After completing the explosion tests, the valves are to be dismantled and the condition of all components ascertained and documented. In particular, any indication of valve sticking or uneven opening is to be noted. Photographic records of the valve condition are to be taken and included in the report.

13.8 Design series qualification

13.8.1 The qualification of quenching devices to prevent the passage of flame can be evaluated for other similar devices of identical type where one device has been tested and found satisfactory.

13.8.2 The quenching ability of a flame screen depends on the total mass of quenching lamellas/mesh. Provided the materials, thickness of materials, depth of lamellas/thickness of mesh layer and the quenching gaps are the same, then the same quenching ability can be qualified for different size of flame arrestors subject to (a) and (b) being satisfied.

(a) $$\frac{n_1}{n_2} = \sqrt{\frac{S_1}{S_2}}$$

(b) $$\frac{A_1}{A_2} = \frac{S_1}{S_2}$$

where

n_1 = number of lamellas of size 1 quenching device for a valve with a relief area equal to S_1
n_2 = number of lamella of size 2 quenching device for a valve with a relief area equal to S_2
A_1 = free area of quenching device for a valve with a relief area equal to S_1
A_2 = free area of quenching device for a valve with a relief area equal to S_2

13.9 The report

13.9.1 The test facility is to deliver a full report that includes the following information and documents:

(a) Test specification.
(b) Details of test pressure vessel and valves tested.
(c) The orientation in which the valve was tested, (vertical or horizontal position).
(d) Methane in air concentration for each test.
(e) Ignition source.
(f) Pressure curves for each test.
(g) Video recordings of each valve test.

13.10 Approval

13.10.1 Approval of an explosion relief valve is the prerogative of LR based on the appraisal of plans and particulars and the test facility's report of the results of type testing.

■ *Section14*
Type testing procedure for crankcase oil mist detection/monitoring and alarm arrangements

14.1 Scope

14.1.1 This test procedure identifies standard conditions by which crankcase oil mist detection/monitoring and alarm equipment and systems intended to be fitted to diesel engines can be tested to demonstrate that they satisfy LR requirements for type testing to a defined standard.

14.1.2 This test procedure is also applicable to oil mist detection/monitoring and alarm arrangements intended for gear cases.

14.2 Purpose

14.2.1 The purpose of type testing crankcase oil mist detection/monitoring and alarm arrangements is seven fold:

(a) To verify the functionality of the system.
(b) To verify the effectiveness of the oil mist detectors.
(c) To verify the accuracy of oil mist detectors.
(d) To verify the alarm set points.
(e) To verify time delays between mist extraction from crankcase and alarm activation.
(f) To verify the operation of alarms to indicate functional failure in the equipment and associated arrangements.
(g) To verify that there is an indication when optical obscuration has reached a level that will affect the reliability of information and alarms.

14.3 Test facilities

14.3.1 The test house carrying out type testing of crankcase oil mist detection/monitoring and alarm equipment and arrangements is to satisfy the following criteria:

(a) The test facilities are to have the full range of facilities for carrying the type and functionality tests required by this procedure and be acceptable to LR.
(b) The test house that verifies that the equipment ascertains the levels of oil mist concentration is to be equipped so that it can control, measure and record oil mist concentration levels in terms of mg/l to an accuracy of ±10 per cent in accordance with this procedure.
(c) The type tests are to be witnessed by a LR Surveyor unless otherwise agreed.
(d) The oil mist concentrations are to be ascertained by the gravimetric deterministic method or equivalent. The gravimetric deterministic method is a laboratory process where the difference in weight of a millipore (typically 0,8 µm) filter is ascertained by weighing the filter before and after drawing 1dm^3 of oil mist through the filter.
(e) The results of a gravimetric analysis are considered invalid and are to be rejected if the resultant calibration curve has an increasing gradient with respect to the oil mist detection/monitoring reading. This situation occurs when insufficient time has been allowed for the oil mist to become homogeneous. Single results that are more than 10 per cent below the calibration curve are to be rejected. This situation occurs when the integrity of the filter unit has been compromised and not all of the oil is collected on the filter paper.
(f) The filters are required to be weighed to a precision of 0,1 mg and the volume of air/oil mist sampled to a precision of 10 ml.

14.4 Equipment testing

14.4.1 The range of tests is to include the following for the alarm/monitoring panel:

(a) Functional tests described in 14.5.
(b) Electrical power supply failure test.
(c) Power supply variation test.
(d) Dry heat test.
(e) Damp heat test.
(f) Vibration test.
(g) EMC test.
(h) Insulation resistance test.
(j) High voltage test.
(k) Static and dynamic inclinations, if moving parts are contained.

14.4.2 The range of tests is to include the following for the detectors:

(a) Functional tests described in 14.5.
(b) Electrical power supply failure test.
(c) Power supply variation test.
(d) Dry heat test.
(e) Damp heat test.
(f) Vibration test.
(g) Insulation resistance test.
(h) High voltage test.
(j) Static and dynamic inclinations, if moving parts are contained.

14.5 Functional test process

14.5.1 All tests to verify the functionality of crankcase oil mist detection/monitoring devices are to be carried out in accordance with 14.5.2 to 14.5.6 with an oil mist concentration in air, known in terms of mg/l to an accuracy of ±10 per cent.

14.5.2 The concentration of oil mist in the test vessel is to be measured in the top and bottom of the vessel and these concentrations are not to differ by more than 10 per cent.

14.5.3 The oil mist monitoring arrangements are to be capable of detecting oil mist in air concentrations of between 0 and 10 per cent of the lower explosive limit (LEL), which corresponds to an oil mist concentration of approximately 50 mg/l (13 per cent oil-air mixture).

14.5.4 The operation of the alarm indicators for oil mist concentration in air are to be verified and are to provide an alarm at a maximum setting corresponding to 5 per cent of the LEL or approximately 2,5 mg/l.

14.5.5 Where alarm set points can be altered, the means of adjustment and indication are to be verified against the equipment manufacturer's instructions.

14.5.6 Where oil mist is drawn into a detector/monitor via piping arrangements, the time delay between the sample leaving the crankcase and operation of the alarm is to be determined for the longest and shortest lengths of pipes recommended by the manufacturer. The pipe arrangements are to be in accordance with the manufacturer's instructions/recommendations.

14.6 Detectors/monitors and equipment to be tested

14.6.1 The detectors/monitors and equipment used in type testing are to be manufactured and tested in accordance with procedures acceptable to LR and selected from the manufacturer's usual production line for such equipment by the LR Surveyor witnessing the tests.

14.6.2 Two sets of detectors/monitors requiring approval are to be tested. One set is to be tested in the clean condition and the other in a condition that represents the maximum degree of lens obscuration that is stated as being acceptable by the manufacturer.

14.7 Method

14.7.1 The following requirements are to be satisfied at type testing:

(a) The testing is to be witnessed by a LR surveyor where type testing approval is required by LR.
(b) Oil mist detection/monitoring devices are to be tested in the orientation in which they intended to be installed on an engine or gear case.
(c) Type testing is to be carried out for each range of oil mist detection/monitoring devices that a manufacturer requires LR approval.
(d) The test house is to produce a test report.

14.8 Assessment

14.8.1 Assessment of oil mist detection/monitoring devices after testing is to address the following:

(a) The devices to be tested are to have evidence of appraisal/approval by LR, *See also* 14.6.1.
(b) The details of the detection/monitoring devices to be tested are to be recorded. This is to include manufacturer, type designation, oil mist concentration assessment capability and alarm settings.
(c) After completing the tests, the detection/monitoring devices are to be examined and the condition of all components ascertained and documented. Photographic records of the monitoring devices condition are to be taken and included in the report.

14.9 Design series qualification

14.9.1 The approval of one detection/monitoring device may be used to qualify other devices having identical construction details. Proposals are to be submitted for consideration.

14.10 The Report

14.10.1 The test house is to provide a full report which includes the following information and documents:

(a) Test specification.
(b) Details of devices tested.
(c) Results of tests.

14.11 Acceptance

14.11.1 Acceptance of crankcase oil mist detection/monitoring devices is the prerogative of LR based on the appraisal of plans and particulars and the test house report of the results of type testing.

14.11.2 The following information is to be submitted to LR for acceptance of oil mist detection/monitoring and alarm arrangements:

(a) Description of oil mist detection/monitoring equipment and system including alarms.
(b) Copy of the test house report identified in 14.10.
(c) Schematic layout of engine oil mist detection/monitoring arrangements showing location of detectors/sensors and piping arrangements and dimensions.
(d) Maintenance and test manual which is to include the following information:
    - Intended use of equipment and its operation.
    - Functionality tests.
    - Maintenance routines and spare parts recommendations.
    - Limit setting and instructions for safe limit levels.
    - Where necessary, details of configurations in which the equipment is and is not to be used.

Existing Sections 13 and 14 have been renumbered Sections 15 and 16.

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